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Development of low-cost feed for culture of giant freshwater prawn (*Macrobrachium rosenbergii* de Man)in ponds

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Abstract
An experiment was conducted for 105 days in 12 earthen mini ponds of each 30 m^2 size. Five different experimental diets containing 32% protein were formulated and prepared using fishmeal, shrimp meal, soybean meal, mustard oil cake, sesame meal, wheat bran and rice bran. A commercial shrimp diet (SABINCO starter-III) was assigned to treatment six and considered as the control. Prawns were stocked at the rate of 2.5 fry/ m^2 and feed twice daily at the rate of 10% at the beginning and reduced to 8% for the last two months. The results of the experiment showed that prawn fed diets 1, 2, and 6 (control) showed significantly ($P<0.05$) highest weight gain among the dietary groups, while prawn fed diet 5 showed significantly lowest weight gain. The FCR values of diets ranged between 3.06 to 4.85. Prawns fed diet 1 and 6 showed significantly higher SGR, survival (%) and production among the dietary groups. The survival (%) of the prawns ranged between 46.6 to 66.6% and the production ranged between 304.5 to 563.3 kg/ha/105 days. The result of the study showed that diet containing 30% fishmeal, 5% shrimp meal, 5% soybean meal, 10% mustard oil cake, 10% sesame meal, 20% wheat bran, 18% rice bran, 1% oyster shell and 1% vitamin premix may be recommended for monoculture of *M. rosenbergii*.

Key words: *M. rosenbergii,* Monoculture, Low-cost feed

Introduction

Although fish culture in ponds and tanks are known in Bangladesh for centuries, freshwater prawn farming has not been expanded widely compared to that of the carp farming. Among the factors that have slowed the expansion of freshwater prawn farming the scarcity of prawn fry (PL), unavailability of formulated pelleted diet and high price of the diet are considered as the main factors. In recent years some hatcheries and fish feed industries have been developed which are contributing effectively to reduce scarcity of prawn fry and the unavailability of the pelleted diet. But the pelleted rations are quite expensive. As a result most of the farmers of Bangladesh are not interested to culture freshwater prawn in their ponds, though the economic value and the market demand of freshwater prawn, *M. rosenbergii* is much higher than that of carp. However, the present

trend shows that freshwater prawn farming is becoming a significant and expanding industry (New 1991).

There is a great potential or successful monoculture of freshwater prawn in numerous ponds of Bangladesh. Now-a-days the production of prawn from natural sources are decreasing day by day. So, scientific prawn culture should be introduced in freshwater ponds. Although some works have been done on the rearing of *M. rosenbergii* with different supplemental feeding and stocking densities (Khan *et al.* 1984, Humayun *et al.* 1986, Mazid *et al.* 1989, Islam *et al.* 1990 and Hoq *et al.* 1996); most of them are on polyculture. Therefore, the present study was undertaken to develop a suitable low-cost diet from indigenous sources for monoculture of *M. rosenbergii* in ponds.

Materials and methods

The experiment was conducted in 12 earthen rain-fed mini ponds of each 30 m^2 size situated behind the Fisheries Faculty Building, Bangladesh Agricultural University (BAU) Campus, Mymensingh during the month from July to October'98. The water depth was maintained to maximum of 1.2 m using fine meshed PVC overflow pipe (2 inches diameter) on the bank fixed at 1.2 m above the pond bottom. All the ponds were of similar size, depth, basin configuration and the bottom type including water supply facilities from a deep tubewell. Undesirable species in the ponds were eradicated by repeated netting followed by application of rotenone (20 g/40m^2). Liming was performed at the rate of 1 kg/40m^2.

For formulation of experimental diets, different feed ingredients such as fish meal, shrimp meal, soybean meal, mustard oil cake, sesame meal, wheat bran, rice bran, oyster shell and vitamin premixes were collected from Dhaka and Mymensingh local markets. The fish meal was of German origin. These ingredients were analysed for their proximate composition (Table 1).

Table 1. Proximate composition of the feed ingredients used (% dry matter basis)

Ingredients	Dry matter	Protein	Lipid	Ash	Crud fibre	NFE[1]
Fish meal	90.12	56.00	14.82	24.10	2.22	2.86
Shrimp meal	92.40	60.10	13.14	22.13	2.14	2.49
Soybean meal	91.26	48.02	18.48	7.36	7.10	19.04
Mustard oilcake	89.12	32.05	12.61	10.40	11.64	33.3
Sesame meal	90.21	28.11	9.42	15.62	22.41	24.44
Wheat bran	89.24	14.24	5.60	6.24	15.26	58.66
Rice bran	90.44	12.40	8.82	10.48	16.34	51.96

NFE[1] = Nitrogen free extract calculated as- 100 - %(moisture + protein + lipid + ash + crude fibre)

Five experimental diets were formulated to contain 32% protein (Table 2.). Diets were also formulated to be isoenergic as far as possible to maintain similar energy levels. A SABINCO shrimp diet (starter-III) from Saudi-Bangla Fish Feed Ltd, Bhaluka, Mymensingh was used as the control. All the collected ingredients were ground finely and sieved through 0.5 mm mesh. After sieving all the required amount of dry

ingredients along with vitamin premix were weighed according to the formulae of experimental diets. The well mixed ingredients were then put into the pellet mill for the preparation of pelleted feed of size 3 mm.

Table 2. Formulation of experimental diets used in Monoculture experiments of *M. rosenbergii*

Ingredients	Diet- 1	Diet- 2	Diet- 3	Diet- 4	Diet- 5
Fish meal	30.0	25.0	20.0	15.0	10.0
Shrimp meal	5.0	5.0	5.0	5.0	5.0
Soybean meal	5.0	10.0	15.0	20.0	25.0
Mustard oilcake	10.0	10.0	12.0	12.0	12.0
Sesame meal	10.0	10.0	12.0	12.0	12.0
Wheat bran	20.0	20.0	20.0	20.0	20.0
Rice bran	18.0	18.0	14.0	14.0	14.0
Oyster shell	1.0	1.0	1.0	1.0	1.0
Vitamin premix[1]	1.0	1.0	1.0	1.0	1.0
Total	100.0	100.0	100.0	100.0	100.0

[1] *"Embavit" fish premix obtain from Rhone-Poulenc (Bangladesh)*

About 0.3 g size PL of *M. rosenbergii* were collected from Chandpur which were originally collected from Dhakatia river. These PLs were brought to Mymensingh in oxygen bags. Ponds were divided into six treatments viz., 1,2,3,4,5 and 6 each having two replicates. *M. rosenbergii* PL of 0.3±0.02g size were stocked at the rate of 2.5 larvae/m^2 in the ponds. Prawns were fed at the rate of 10% of body weight at the beginning. The feeding rate was reduced to 8% of the body weight for the last two months. Fortnightly random sampling was done using seine net to monitor growth of prawn and to adjust the feeding rate. Water quality parameters such as temperature, dissolved oxygen and pH were monitored fortnightly and the ranges were : temperature 28.7 to 31.5^{0}C, dissolved oxygen 3.0 to 6.1mg/e and pH 6.8 to 8.4.

The proximate composition of feed ingredients and experimental diets were analyzed according to the methods given in Association of Official Analytical Chemists (AOAC 1980). One way analysis of Variance (ANOVA) was used to determine the effects of feed on the growth of prawn. This was followed by Duncan's New Multiple Range Test (Duncan 1955) at 5% level of significance to observe any difference among treatment means. Standard error (± SE) of treatment means were calculated from the residual means square in the analysis of variance.

A simple economic analysis was performed to estimate the net profit from monoculture system of prawn. The cost of production was based on the Mymensingh whole sale market price (1998) for the inputs used. The cost of prawn larvae was : Tk. 4/PL. The cost of feed ingredients was: (a) fish meal: Tk. 30/kg, (b) shrimp meal: Tk. 40/kg, (c) soybean meal: Tk. 12/kg, (d) sesame meal: Tk. 7/kg, (e) mustard oilcake: Tk. 6/kg, (f) rice bran: Tk. 4/kg, (g) wheat bran: Tk. 5/kg, (h) oyster shell: Tk. 7/kg and (i) vitamin premixes: Tk. 160/kg. The sale price for prawn was assumed as on average Tk.

250/kg. The cost of leasing ponds was not included in the total cost. An additional 7.5% on total cost was included as operational cost according to ADCP (1983).

Results

The proximate composition of experimental diets including the control are shown in Table 3. There was slight variation in protein, crude fibre, and NFE content. The protein content in different experimental diets varied between 32.10% and 33.25%. The lipid content in different diets varied between 9.41% and 11.09% with diet 5 showing the highest lipid (11.09%) content. This might be due to the higher soybean meal content in diet 5 as soybean meal originally contained high lipid content (18.48%). The ash content in different diets varied between 13.20% and 14.31%. In the control diet (SABINCO) the protein, lipid and ash content were 35.10, 8.79 and 12.57% respectively.

Table 3. Analysed proximate composition of the experimental diets used in *M. rosenbergii* monoculture experiment (% dry matter basis)

Components	Diets					
	1	2	3	4	5	6 (SABINCO)
Dry matter	90.29	91.12	90.49	90.31	90.19	90.57
Protein	33.05	32.10	32.50	33.25	32.40	35.10
Lipid	9.41	10.35	10.54	10.41	11.09	8.79
Ash	14.31	14.13	14.10	13.20	13.48	12.57
Crude fibre	11.10	10.80	11.05	11.28	11.30	9.36
NFE[1]	32.13	32.62	31.81	31.86	31.73	34.18
G.E. (kJ/g)[2]	16.73	16.98	16.97	17.10	17.14	17.30
Cost (Tk./kg)	18.19	17.29	16.49	15.59	14.69	45.00

NFE[1] = Nitrogen free extract calculated as- 100 - %(moisture + protein + lipid + ash + crude fibre)
G.E.[2] - Gross Energy.

Growth performance of prawn in different treatments in terms of mean weight gain (g) and total length (cm), specific growth rate (SGR %day), feed conversion ratio (FCR), survival and total production (kg/treatment) are shown in Table 4. The prawns fed on diets 1,2 and 6 (SABINCO) showed significantly higher mean total length. The significantly lowest total length was found in treatment 5. The prawns fed on diets 1, 2 and 6 (control) showed significantly ($P<0.05$) higher weight gain among the dietary groups. The significantly lowest growth was found in the treatment 5.

The specific growth rate (SGR) values of prawns ranged between 4.32 and 4.50 with diets 1, 2 and 6 exhibiting the higher SGRs. There was no significant difference ($P>0.05$) between the SGR values of diets 4 and 5. The mean feed conversion ratio (FCR) values varied between 3.11 and 4.85. The lowest FCR value (3.06) was observed with diets 1, 2 and 6. Diet 5 showed the highest FCR value (4.85). Survival (%) of prawns were estimated after total harvesting by draining out the ponds. The survival (%) of prawns varied between 46.60 and 66.6 % with diets 1, 2 and 6 showing significantly the higher survival. The lowest survival rate (46.6%) was recorded with prawns receiving diet 5.

Table 4. Growth performance of *M. rosenbergii* in monoculture fed on experimental diets

Parameters	Diets 1	2	3	4	5	6	± S.E.
Mean initial length (cm)	5.0	5.0	5.0	5.0	5.0	5.0	-
Mean final length (cm)	15.0^{a}	15.1^{a}	14.3^{ab}	13.8^{bc}	13.0^{c}	15.1^{a}	± 0.28
Mean initial weight (g)	0.3^{a}	0.3^{a}	0.3^{a}	0.3^{a}	0.3^{a}	0.3^{a}	-
Mean final weight (g)	33.8^{a}	33.1^{a}	29.5^{b}	28.1^{c}	26.0^{c}	34.0^{a}	± 0.75
Weight gain (g)	33.5^{a}	32.8^{a}	29.2^{b}	27.8^{c}	25.7^{c}	33.7^{a}	± 0.75
SGR (%day)	4.50^{a}	4.48^{a}	4.37^{b}	4.32^{b}	4.24^{c}	4.50^{a}	± 0.02
FCR	3.06^{a}	3.23^{a}	3.92^{b}	4.14^{b}	4.85^{c}	3.11^{a}	± 0.13
Survival (%)	66.6^{a}	64.0^{a}	54.6^{b}	52.0^{b}	46.6^{c}	65.3^{a}	± 0.99
Production (kg/treatment)	1.69^{a}	1.59^{b}	1.21^{c}	1.10^{d}	0.91^{e}	1.67^{a}	± 0.03
Production (kg/ha/105 days)	563.3^{a}	529.6^{b}	403.2^{c}	365.3^{d}	304.5^{e}	557.3^{a}	± 2.26

** Superscript (s) in the same row indicate no significant difference.*
SGR = Specific growth rate (% day)
FCR = Food conversion ratio.

Total production of prawn in terms of kg/treatment ranged between 0.91 and 1.69 kg in different treatments. Prawns fed on diets 1 and 6 resulted in significantly ($P<0.05$) higher production. The lowest production (0.91 kg) was obtained with treatment 5. The production ranged between 304.5 and 563.3 kg/ha/105 days.

A simple cost and return analysis was performed to estimate the net profit derived from monoculture of *M. rosenbergii* in ponds with formulated pelleted diets (Table 5). The highest net profit (Tk. 51,443/ha/105 days) was obtained in 1 and a loss of profit of Tk. 28,433/ha/105 days was observed in treatment 6. Treatments 3, 4 and 5 also resulted in loss in profit.

Table 5. Economic analysis of prawn production in monoculture experiment

Investment (Tk.)	Treatments I	II	III	IV	V	VI
i) Lime, fertilizer and rotenone	9.00	9.00	9.00	9.00	9.00	9.00
ii) Cost of fry	225.00	225.00	225.00	225.00	225.00	225.00
iii) Feed cost	94.07	88.80	78.22	71.00	64.83	233.72
Operational cost*	24.60	24.21	23.41	22.88	22.41	35.08
Total cost	352.67	347.01	335.63	327.88	321.24	502.80
Gross income (Tk.) from sale	507.00	477.00	302.50	275.00	227.50	417.50
Net profit (Tk./treatment)	154.33	129.99	- 33.13	- 52.88	- 93.74	- 85.30
Net profit (Tk./ha/105 days)	51443	43330	-11043	- 17627	- 31247	- 28433

Sale price : Average Tk. 250/kg
** Operational cost is considered as 7.5% of total cost (ADCP, 1983)*
*** Leasing cost for pond is not included.*

Discussion

The physico-chemical parameters observed in the present study were within the suitable range for fish culture. Only exception was the sudden drop of dissolved oxygen at early morning in the later part of the experiment causing few prawn mortality. During late September, the dissolved oxygen level in some experimental ponds dropped to 1.0 *mg/l* in the early morning (at 4.00 a.m.) with cloudy sky. This resulted in mortalities of few prawns. Similar type of prawn mortalities were also reported by Mazid and Mahmood (1994) and Humayun *et al.* (1986) in *M. rosenbergii* in monoculture ponds with supplemental feed. Wulff (1982) reported that juveniles of freshwater prawn could tolerate minimum oxygen levels of 1.0-1.5 *mg/l* and suggested not to allow the prawns at such levels for long time.

The stocking densities of prawn in the present study was 2.5/m^2. Thangdurai (1991) reported that a stocking density of 3/m^2 was optimum in India feeding on a combination of groundnut cake, rice bran and fish flesh. By investigating the potential of *M. rosenbergii* culture in Malaysia obtained 977 kg/ha/158 days cycle with 32.4% survival, when prawns were stocked at 10/m^2 and feed 30% protein ration at 20, 10 and 5% body weight daily for the first, second and subsequent months respectively (Ang, 1990).

Daniels *et al.* (1995) reported a higher survival rate of 73.7 to 81.9% with *M. rosenbergi* fed a specially formulated diet in earthen ponds. The production of prawn in the present study range between 304.5 to 563.3 kg/ha/105 days which are higher than that of Mazid and Mahmood (1994) but lower than that of Ang (1990).

Law *et al.* (1990) suggested that copra cake, soybean meal and wheat flour (which are low-cost ingredients in the Malaysia) were good sources of nutrients for prawn having examined their digestibility in 30 or 40% protein feeds with juveniles and adults. Generally, adult prawns could digest these ingredients and shrimp and fish meals, better than juveniles. Durairaj *et al.* (1992) noted an improved growth rate when prawns in manured ponds were fed a pelleted feed containing shrimp head meal (20%) and fish meal (10%) rather than a conventional feed ratio 1:2:1 groundnut oilcake, rice bran and trash fish but the trial was unreplicated.

The survival rate, individual weight and feed conversion ratio of the diet 1, 2 and 6 of the present study (65.3%, 33.6g and 3.13:1 respectively) were more or less similar to that of Tidwell *et al.* (1993). Who reported that the survival, individual weight and feed conversion ratio of 78%, 42g and 2.9:1 respectively in the monoculture of *M. rosenbergii* using formulated diet containing 32% protein.

The maximum yield (1.69 kg/treatment) in the present study was obtained in treatment 1. A simple economic analysis also revealed that treatment 1 could generate maximum net profit of Tk. 51,443 per hectare in 105 days. The total production in treatment 6 (using SABINCO diet) was more or less similar to that of treatment 1, but the net profit of treatment 6 was negative. This was due to the higher cost of SABINCO diet used in treatment 6. The loss in profit in other treatment (3, 4, and 5) may be due to the higher mortality of prawn or low stocking density used which decreased the total production.

In the present study, prawns fed diets, 1, 2 and 6 (SABINCO diet) attained the higher weight gain. There was no significant ($P>0.05$) difference between the weight gain of prawn fed diets 1, 2 and the control diet 6. Considering, the growth performance of prawn and the price of the experimental diet-1 (Tk. 18.19/kg) compared to that of SABNCO shrimp diet (Tk. 45/kg), diet-1 (containing 30% Fish meal, 5% Shrimp meal, 5% Soybean meal, 10% Mustard oilcake, 10% Sesame meal, 20% Wheat bran, 18% Rice bran, 1% Oyster shell and 1% Vitamin premix) may be recommended for monoculture of *M. rosenbergii* in ponds. However, further study should be carried out to find out an optimum stocking density of *M. rosenbergii* for monoculture in ponds.

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